



Atty. Dkt. No. 061887-0121

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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

Applicant: Geun-Young YEOM et al.

Title: LAYER-BY-LAYER ETCHING APPARATUS USING NEUTRAL BEAM
AND METHOD OF ETCHING USING THE SAME

Appl. No.: 10/086,497

Filing Date: 02/28/2002

Examiner: Luz Alejandro Mulero

Art Unit: 2173

BRIEF ON APPEAL

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Under the provisions of 37 C.F.R. § 41.37, this Appeal Brief is being filed together with a check in the amount of \$340.00 covering the Rule 41.20(b)(2) appeal fee. If this fee is deemed to be insufficient, authorization is hereby given to charge any deficiency (or credit any balance) to the undersigned deposit account 19-0741.

1. REAL PARTY IN INTEREST

The real party in interest is the assignee of record, Sungkyunkwan University.

2. RELATED APPEALS AND INTERFERENCES

There are no related Appeals or Interferences.

3. STATUS OF CLAIMS

Claims 1, 4-7 and 17-18 are pending. Claims 2-3, 8-16 and 19-21 are cancelled. Claim 4 is withdrawn from consideration. Claims 1, 5-7 and 17-18 are rejected, and are the subject of this appeal.

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4. STATUS OF AMENDMENTS

The present application is under a final rejection (See Final Rejection mailed April 27, 2004). Appeal of claims 1, 5-7 and 17-18 is appropriate because all of these claims have been twice rejected. See 35 U.S.C. § 134(a). The Amendment after final rejection filed on July 20, 2004 (the “July 20 Amendment”) is entered for the purposes of this Appeal (See Advisory Action mailed August 25, 2004).

A Claims Appendix lists the claims and their current status.

5. SUMMARY OF CLAIMED SUBJECT MATTER

The present invention relates to a layer-by-layer etching apparatus.

Figure 1 and paragraphs 29 and 30 of the specification illustrate the layer-by-layer etching apparatus generally. The layer-by-layer etching apparatus (See Fig. 1, specification, paragraph 29) comprises a number of components including: a reaction chamber (90) having a stage (60) therein on which a substrate to be etched (62) is mounted, a neutral beam generator (10), a shutter (20) disposed between the neutral beam generator and the reaction chamber, for controlling the supply of the neutral beam into the reaction chamber, an etching gas supply (30) for supplying an etching gas into the reaction chamber, a purge gas supply (See purge gas supply inlet 80) for supplying a purge gas into the reaction chamber and a controller (50) for controlling the supply of a source gas, the etching gas, and the purge gas and opening and closing the shutter (See paragraph [0030]).

The neutral beam generator (10) is shown in more detail in Figure 4. The neutral beam generator includes an ion source (210) for extracting an ion beam having a predetermined polarity from a source gas and for accelerating the ion beam (See paragraphs [0035] and [0036]), and a plate-shape reflector (218) which is positioned in a path of the accelerated ion beam and is tiltable to control an incident angle of the accelerated ion beam in a range of 75 to 85 degrees from a vertical line with respect to a surface of the reflector (See

paragraph [0039]), whereby the reflector reflects and neutralizes the accelerated ion beam to generate a neutral beam and to supply the neutral beam into the reaction chamber.

6. GROUND OF REJECTION TO BE REVIEWED ON APPEAL

The grounds of rejection to be reviewed on appeal are:

A. the rejection of claims 1, 5, 7 and 17-18 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,401,358 to Kadomura et al. (hereafter “Kadomura”) in view of U.S. Patent No. 5,883,005 to Minton et al. (hereafter “Minton”), U.S. Patent No. 5,342,448 to Hamamura (hereafter “Hamamura”) and U.S. Patent No. 4,662,977 to Motley et al. (hereafter “Motley”); and

B. the rejection of claim 6 under 35 U.S.C. § 103(a) as being unpatentable over Kadomura, Minton, Hamamura and Motley in view of U.S. Patent No. 6,331,701 to Chen et al. (hereafter “Chen”) or U.S. Patent No. 5,036,252 to Lob (hereafter “Lob”).

7. ARGUMENT

A. The rejection of claims 1, 5, 7 and 17-18 under 35 U.S.C. § 103(a) as being unpatentable over Kadomura in view of Minton, Hamamura, and Motley.

(claims 1, 5, 7 and 17-18, of which claim 1 is independent)

The references fail to suggest a number of the features of the layer-by-layer etching apparatus of independent claim 1. Claim 1 includes, among other components, (a) “a plate-shape reflector which is positioned in a path of the accelerated beam and is tiltable. . . , whereby the reflector reflects and neutralizes the accelerated ion beam”, (b) “a shutter disposed between the neutral beam generator and the reaction chamber, for controlling the supply of the neutral beam into the reaction chamber”, and (c) “a purge gas supply for supplying a purge gas into the reaction chamber.” The references cited in the rejection fail to disclose or suggest any of (a), (b) or (c) in the context of the apparatus as claimed in claim 1.

purge gas supply

The references cited in the rejection fail to disclose or suggest the purge gas supply as recited in claim 1. The Examiner on page 3 of the Final Office Action cites to Kadomura at Fig. 3, col. 5, line 62 to col. 7, line 5 as disclosing a purge gas supply for supplying a purge gas into a reaction chamber (which the Final Office Action equates with the neutral beam irradiation chamber 20 of Kadomura). Kadomura, however, does not disclose a purge gas supply in the cited section of Kadomura, or in either of its two disclosed embodiments of Figure 1 and Figure 3. Kadomura does disclose an ion generating chamber 21 for supplying ions to neutral beam irradiation chamber 20 (which the Final Office Action equates with reaction chamber as claimed), and a plasma generating chamber 27 for supplying a plasma to chamber 20 (See Kadomura, Fig. 3, col. 6, lines 18-36). Kadomura, however, does not have structure that supplies a purge gas to the chamber 20. Thus, Kadomura fails to disclose the purge gas supply as recited in claim 1.

shutter

Kadomura also fails to disclose the shutter as recited in claim 1. The Examiner on page 3 of the Final Office Action correctly acknowledges that Kadomura fails to disclose a shutter, but argues that it would have been obvious to modify the apparatus of Kadomura to include the shutter of Minton. Appellants respectfully disagree at least because one skilled in the art would not have been motivated to modify Kadomura to include the shutter described by Minton, and even if Kadomura were so modified, the resultant system would not include a shutter *between* a neutral beam generator and a reaction chamber, as required by claim 1.

Kadomura discloses an ion generating chamber 21 that ionizes Ar gas (col. 6, lines 18-20, and 55-58), and draws the ionized Ar into a neutral beam irradiation chamber 20 where the ions are neutralized by a charge exchange reaction with a background gas before being incident on a wafer via a charged particle removal electrode 26 (col. 6, lines 20-24).

Minton discloses a system using pulsed laser radiation 14 to breakdown gas in nozzle 8 by heating the gas to a very high temperature (col. 5, lines 50-56). The heated gas breaks down into numerous species including neutral atoms and ions, i.e. plasma (col. 5, lines 60-

62). The plasma expands inside the nozzle 8 and further in chamber 2 resulting in a hyperthermal beam of neutral reactive species (col. 5, lines 62-65). A motor mounted shutter 20, specifically a wide slot wheel, is employed to select a portion of the reactive species having a relatively narrow velocity range (col. 6, lines 35-40, and 54-56).

One skilled in the art would not have been motivated to include the shutter of Minton to shutter the neutral Ar beam of Kadomura. The shutter of Minton, a rotating wide slot wheel, is designed to be *synchronized* with the *pulsed* laser radiation so that only particles within a *particular narrow velocity range* pass through the slot of the wheel. The purpose of the shutter in Minton is to select out a narrow velocity range of particles, and to do this, the shutter must be synchronized with a pulsed source of the particles. The Kadomura system, by contrast, is not a system where neutral reactive species are formed by a pulsed laser, nor are the neutral reactive species formed in any pulsed manner. Thus, including the synchronized shutter of Minton in the Kadomura system could not select out a velocity range of particles, so that one skilled in the art would have no reason to include it in the Kadomura system.

Moreover, the shutter as recited in claim 1 is disposed *between* the neutral beam generator and the reaction chamber. In Kadomura, neutralizing the Ar ions occurs via the electrode 26 *within* the chamber 20. Modifying the Kadomura system to include a shutter to block neutral species would necessarily require that the shutter be disposed within the chamber 20, in contrast to claim 1. Thus, even if Kadomura were modified to include a shutter, the resultant apparatus would not meet the limitations of claim 1.

plate-shape reflector

Kadomura also fails to disclose the plate-shape reflector which is tiltable as recited in claim 1. The Examiner correctly acknowledges in the Office Action on page 4 that Kadomura fails to disclose a plate-shape reflector as recited in claim 1, but argues that it would have been obvious to modify the apparatus of Kadomura to include the plate of Motley. Motley provides no motivation to modify the Kadomura reference to include such a tiltable reflector. Kadomura discloses using a charged particle removal electrode 26 to

neutralize charged Ar particles. With respect to modifying Kadomura in view of Motley the Examiner states on page 4 of the Office Action:

Motley et al. discloses the use of a plate-shape metal tiltable reflector positioned in the path of the beam for reflecting and neutralizing the beam (see, for example, fig. 1 and its description). Therefore, in view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the apparatus of Kadomura modified by Minton et al. and Hamamura et al. so as to comprise a plate-shape metal tiltable reflector in order [to] reflect and neutralize the ion beam.

The Examiner, however, provides no motivation for why one skilled in the art would replace the charged particle removal electrode 26 of Kadomura with a plate shaped tiltable reflector to neutralize the particles, and thus has failed to meet the Examiner's burden of establishing a *prima facie* case of obviousness.

Claim 1 further requires that the plate-shape reflector "is tiltable to control an incident angle of the accelerated beam in a range of 75 to 85 degree from a vertical line with respect to a surface of the reflector." The Final Office Action alleges on page 4 that the specific claimed tiltable range is directed to a method limitation, and argues that method limitations are viewed as intended uses that do not further limit the claimed invention. Appellants respectfully submit that the tiltable range in claim 1 is not merely a method of use limitation. In claim 1, the reflector must be capable of being tilted in a range of 75 to 85 degrees. This limitation clearly distinguishes the reflector from a system which has a plate which may not be tilted within the recited range, for example for the case where the plate is fixed such that the angle is outside of the recited range. Appellants respectfully submit that all of the limitations of claim 1 must be given weight in interpreting claim 1.

Motley does not disclose that the plate 50 is capable of being rotated "to control an incident angle of the accelerated beam in a range of 75 to 85 degrees from a vertical line with respect to a surface of the reflector" as in claim 1. Motley discloses specifically an angle of 45 degrees (col. 4, lines 3-6), and Figure 1 of Motley does not suggest that the range of angles includes 75 to 85 degrees.

8. CONCLUSION

For at least the foregoing reasons, it is submitted that the Examiner's rejections are erroneous, and reversal of the applied rejections is respectfully requested.

Respectfully submitted,

Date

October 26, 2004

By

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CLAIMS APPENDIX

Presently Pending Claims

1. (Previously Presented) A layer-by-layer etching apparatus using a neutral beam, the layer-by-layer etching apparatus comprising:

a reaction chamber having a stage therein on which a substrate to be etched is mounted;

a neutral beam generator, including:

an ion source for extracting an ion beam having a predetermined polarity from a source gas and for accelerating the ion beam; and

a plate-shape reflector which is positioned in a path of the accelerated ion beam and is tiltable to control an incident angle of the accelerated ion beam in a range of 75 to 85 degree from a vertical line with respect to a surface of the reflector, whereby the reflector reflects and neutralizes the accelerated ion beam to generate a neutral beam and to supply the neutral beam into the reaction chamber;

a shutter disposed between the neutral beam generator and the reaction chamber, for controlling the supply of the neutral beam into the reaction chamber;

an etching gas supply for supplying an etching gas into the reaction chamber;

a purge gas supply for supplying a purge gas into the reaction chamber; and

a controller for controlling the supply of the source gas, the etching gas, and the purge gas and opening and closing the shutter.

2. – 3. (Cancelled)

4. (Withdrawn) The layer-by-layer etching apparatus of claim 1, wherein the reflector comprises a plurality of co-centric cylindrical reflecting members and different polar voltages are applied to adjacent reflecting members.

5. (Previously Presented) The layer-by-layer etching apparatus of claim 1, wherein the reflector is one of a semiconductor substrate, a silicone dioxide substrate, or a metal substrate.

Hamamura does not cure the deficiencies of Kadomura, Minton and Motley. Hamamura was cited for allegedly disclosing a gas controller and a shutter controller. Hamamura, however, does not suggest that Kadomura should be modified to include any of (a) “a plate-shape reflector which is positioned in a path of the accelerated beam and is tiltable . . . , whereby the reflector reflects and neutralizes the accelerated ion beam”, (b) “a shutter disposed between the neutral beam generator and the reaction chamber, for controlling the supply of the neutral beam into the reaction chamber”, or (c) “a purge gas supply for supplying a purge gas into the reaction chamber” as recited in claim 1.

Finally, appellants note that a four reference combination (Kadomura, Minton, Hamamura and Motley) indicates improper use of hindsight reconstruction of appellants’ claimed invention using appellants’ claims as a blueprint.

Dependent claims 5, 7 and 17-18 ultimately depend from claim 1 and are patentable for at least the same reasons, as well as for further patentable features recited therein.

B. The rejection of claim 6 under 35 U.S.C. § 103(a) as being unpatentable over Kadomura, Minton, Hamamura and Motley in view of Chen or Lob.

(claim 6)

Claim 6 depends from independent claim 1, and thus the reasons claim 1 is patentable over Kadomura, Minton, Hamamura and Motley apply equally well to claim 6. Chen and Lob do not cure the deficiencies of Kadomura, Minton, Motley and Hamamura. Chen and Lob were cited for allegedly disclosing a particular type of ion source. Neither Chen nor Lob, however, suggest that Kadomura should be modified to include any of (a) “a plate-shape reflector which is positioned in a path of the accelerated beam and is tiltable . . . , whereby the reflector reflects and neutralizes the accelerated ion beam”, (b) “a shutter disposed between the neutral beam generator and the reaction chamber, for controlling the supply of the neutral beam into the reaction chamber”, or (c) “a purge gas supply for supplying a purge gas into the reaction chamber” as recited in claim 1. Thus, claim 6 is patentable over Kadomura, Minton, Hamamura, Motley, Chen and Lob.

6. (Previously Presented) The layer-by-layer etching apparatus of claim 1, wherein the ion source is one of a high-density helicon plasma ion gun or an ICP-type ion gun.

7. (Previously Presented) The layer-by-layer etching apparatus of claim 1, wherein the substrate to be etched contains silicon.

8. – 16. (Cancelled)

17. (Previously Presented) The layer-by-layer etching apparatus of claim 1, wherein the neutral beam is an argon neutral beam.

18. (Previously Presented) The layer-by-layer etching apparatus of claim 1, wherein the etching gas comprises a chlorine gas.

19. - 21. (Cancelled)